19. (amended) An apparatus for storing video pixel data as at least one full size image at a first resolution, and at least one reduced size image thereof at a second lower resolution, [of pixel data] comprising:

random access memory means having an input port and an output port, for storing the video pixel data presented at the [an] input port [and having at least one output port];

[means for storing] said video pixel data representing the [a] full size video image at a first resolution being stored in a first group of memory locations in said random access memory means;

bulk storage memory for also storing the video pixel data and for presenting selected groups [blocks] of video data at said input port for storage by said random access memory means;

size reducing means responsive [coupled] to said random access memory means for directly receiving [accessing] said [image] video pixel data stored in said random access memory means representing said full size image at said first resolution, and for reducing said image to the [a] reduced size [counterpart] image at the [a] second[,] lower resolution, and for supplying [storing] said reduced size image at said second resolution directly back to [in] said random access memory means in a second group of memory [storage] locations therein; [and]

control means coupled to said random access memory means, to said bulk storage memory [means] and to said size reducing means, for causing said size reducing means to generate said reduced size image at said second resolution and to supply [store] same to [in] said random access memory means in said second group of memory [storage] locations; and

said control means further causing the transfer of [each time] the full size and reduced size video pixel data from said random access memory means [is to be transferred] to said bulk storage memory [means] for storage, [and for causing the video pixel data from both said first and second plurality of memory locations in said random access memory means to be transferred to said bulk storage means for storage after said reduced size image is generated and stored in said second group of storage locations,] and for causing the selective transfer [of video pixel data] from said bulk storage memory directly [means] into said random access memory means of [for storage such that] either said full size image at said first resolution [image] or said [only the] reduced size image at said second lower resolution [counterpart are transferred into said random access memory means].

20. (amended) The apparatus of claim 19 wherein said control means also determines the [is coupled for causing] selective transfer of said reduced size image at

said second resolution [image directly] from said size reducing means into said bulk storage memory via the random access memory means.

21. (amended) The apparatus of claim 19 wherein said control means also determines [is coupled for controlling] the memory locations in said random access memory means where the video pixel data defining said reduced size image at said second resolution [image] are stored upon transfer from said bulk storage memory [means].

I4 Cont

22. (amended) The apparatus of claim 19 [21] wherein said size reducing means produces said reduced size image at said second resolution [image] with one fourth [1/16th] the spatial resolution of said full size image at said first resolution, [image] and wherein said control means determines the [is coupled for causing] transfer of said reduced size image at said second resolution [image] into said random access memory means for storage at a selected one of 16 predetermined groups [blocks] of said memory locations.

SUBJ 2

23. (amended) A system for storing [and retrieving] video data representing video images which are displayable [displayed] as rasters of vertically distributed horizontal lines, each represented video image normally

occupying a raster of selected vertical and horizontal size, the system comprising:

a video image size reducer having an input for receiving [coupled to receive] video data representing a video image corresponding to the [a] selected raster size and for generating [generate therefrom at an output] video data representing a reproduction of said video image at [corresponding to] a selected fractional-size of said selected raster size;

I4 cont

a first store [having an input] for receiving video data for storage and [an output] for providing video data therefrom [retrieved from storage], said first store having a capacity for storing the video data representing a video image corresponding to [of] the selected raster size together with video data representing said [a] reproduction of a video image at [corresponding to] the selected fractional-size [of said selected raster size];

a second store [having an input] for receiving and storing both the video data from the first store [for storage] and [an output] for providing video data therefrom [retrieved from storage], said second store having a capacity for storing video data representing a plurality of video images each corresponding to [a video frame of] the selected raster size, and video data representing a plurality of the reproductions [reproduction] of each video image at the [of] selected fractional-size of said selected raster size; and

I4 Cancel

means for selectively transferring from said second [first] store to said first [second] store either said video data representing one of the plurality of [a] video images [image] corresponding to the selected raster size, or said video data representing the plurality of reproductions [a reproduction] of each [a] video image at [which is] the selected fractional-size of said selected raster size.

Claims 24, 25, please cancel without prejudice.

I5 cont

26. (amended) The method of claim 29 [24] wherein each one of the full size images [image] occupies upon display a raster of selected vertical and horizontal size, [and] further comprising: [the steps of]

storing the [a] plurality of full size images and the plurality of their reduced size reproduction images; [and]

retrieving [accessing] the [a] plurality of reproductions of each video image [selected reduced size images]; [and]

storing the plurality of reproductions [them] in a random access memory; and

outputting the [group of] stored plurality of reproductions [reduced size reproduction images] as a mosaic of reproduction images occupying a raster of the selected vertical and horizontal size.

11
27. (amended) A method of storing video pixel data comprising:

receiving and storing in selected storage locations in a random access memory, full video pixel data comprising a full size image;

generating from the full video pixel data, reduced [therefrom] video pixel data representing a reproduction thereof in the form of a reduced size image at a lower resolution; [from the full size image data and]

storing the reduced video pixel data representing the reduced size image [so generated] in additional storage locations in said random access memory along with the full video pixel data [size image];

storing both the full size image and the reduced size image in bulk storage memory; and

selectively transferring either the full size image or the reduced size image from said bulk storage memory [means] into said random access memory [means] for further processing.

I-5 cont

12
28. (amended) A video still store system comprising:

an external source for supplying a plurality of full size image data sets representative of corresponding full size images;

an image store for storing said full size image data sets [representing a plurality of full size

images], and for storing a like plurality of reduced size image data sets representing a plurality of reduced size images, each of said reduced size image data sets corresponding to one of the full size image data sets;

[an external source input for receiving from an external source full size image data sets;]

a memory for simultaneous storage of one of said full size image data sets and a [the] corresponding one of said reduced size image data sets;

I5 cont

a size reducer means for receiving from said memory the stored one of said full size image data sets, and for producing and returning to said memory the corresponding one of said reduced size image data sets [set];

said memory being responsive [coupled and operative] to [selectively receive from] either the external source [input] or the image store for storing [and to store] said one of said full size image data sets, [and to output as an output image the stored one of said full size image data sets, and to communicate to the size reducer the stored one of said full size image data sets, and to receive from the size reducer and to store the corresponding reduced size image data set,] and for supplying [to provide] to the image store both the stored one of said full size image data sets and the corresponding one of said reduced size image data sets; [set,]

said memory being responsive to [and to receive from] the image store [and] to store at different

selected locations the [selected ones of said] plurality of reduced size image data sets;[, and]

said memory further supplying [to output] as an [said] output image either the plurality of reduced size image data sets arranged [stored selected ones such that the selected one are disposed] at different locations within the output image, or the [to receive and store from said image store only a] full size [sized] image data set; and

means responsive to [retrieve data from] said memory for displaying the output image as [and display it on] a raster scanned video display.

I 5 conch

[Please add the following new Claim 29 to replace original Claims 24, 25.]

SUBJ37

--29. A method of storing video pixel data for access and display comprising:

providing data sets for a plurality of full size images at a first spatial resolution;

generating, from the data sets of the full size images, second data sets representing a corresponding plurality of reduced size reproduction images at a second lower spatial resolution;

storing both the data sets of the plurality of full size images and the data sets of the corresponding plurality of reduced size reproduction images in respective selected groups of storage locations; and

I 6 cont

I b concl

selectively accessing either one of the data sets of the plurality of full size images or the sets of the corresponding plurality of the reduced size reproduction images simultaneously.--

REMARKS

By this amendment, Claims 24, 25 are cancelled without prejudice and replaced by new Claim 29; Claims 2-4, 6, 7, 15-23, 26-28 are variously amended and along with Claim 29 are submitted for consideration in view of the remarks following. Applicant notes with appreciation the allowance of Claims 2, 15, 18, 19, 27, 28 if amended to overcome the rejection under 35 USC 112, and the allowance of Claims 3, 4, 6, 7, 20-22 if amended to overcome the 35 USC 112 rejection, and to include the limitations of the base and intervening claims.

In his Office Action, the Examiner rejected Claims 2-4, 6, 7, 15-28 under 35 USC 112, second paragraph; and Claims 16, 17, 23-26 under 35 USC 102(b) as anticipated by Taylor et al, '776.

Applicant has carefully reviewed the specification and has corrected various inconsistencies therein. The claims have also been carefully reviewed particularly in light of the Examiner's rejections and helpful suggestions, and have been amended throughout in keeping with the Examiner's suggestions as well as for purposes of standardizing and/or clarifying the language thereof.

More particularly, regarding the rejection under 35 USC 112, second paragraph, the specific suggestions in Items (paragraphs) 1-6, 8-13, 18-19 and 23-25, of the Office Action, pages 1-4, have been complied with.

In Items 15-17, 21, 29 and 30 the claims in question have been amended to positively recite antecedents for the various terms referred to by the Examiner.

In Item 7, the term "one-fourth" is correct for the term "spatial resolution". One-sixteenth refers to the storage capacity of a single full size image, that is, over a picture raster. (See page 6, lines 15-18). Claim 22 also has been corrected.

In Item 14, lines 23, 24 (of the original claims) the storage refers to both the full size and reduced size data sets as clarified.

In Item 20, lines 13, 14, "either" image (is) stored.

In Item 22, line 2, the means being accessed is now clearly identified.

In Item 26, the passage in lines 9, 10 was deleted as redundant, and the language in lines 5-8 is amended to clarify the storage of full and reduced size image data.

In Items 27, 28, the "video pixel data" and "said succession of full size images" properly refer back to lines 5, 6 and line 6, respectively, of the original claims.

In Items 31 and 32, Claim 25 has been cancelled.

In Item 33, Claim 26 is now made dependent on new Claim 29, and in line 1, "each one of the full size inages" refers back to Claim 29, lines 3-4. In lines 4-5 of original Claim 26, the "reduced size reproduction images" are recited in new Claim 29, line 7.

In Item 34, original Claim 26, line 7, "outputting the stored plurality of..." properly refers back to Claim 29, line 11.

In Item 35, Claims 27 and 28 have been carefully amended to clarify similar problems in antecedents as corrected in the other claims.

In Item 36, Applicant has deleted the term "operable" throughout all the claims and believes the claims as amended herein now recite language which is definite.

Accordingly, Applicant respectfully requests the withdrawal of the rejection under 35 USC 112, second paragraph, of Claims 2-4, 6, 7, 15-28 (and 29).

Regarding now the rejection of Claims 16, 17, 23-26 under 35 USC 102(b) as anticipated by Taylor et al, '776, Applicant has amended Claim 16, and has re-written Claims 24, 25 as new Claim 29. It is submitted that Taylor et al fails to anticipate the features in independent Claims 16 and 29, as well as independent Claim 23.

More particularly, Taylor et al may, in fact, include two stores, or memories 14/24 and 18/20, and an image size changer 23. However there is no further similarity to Applicant's invention as described and claimed.

The electronic arrangement and cooperating functions of the electronics are not similar, and are not the equivalent of the cooperating functions of Applicant's combination, as recited in Claims 16, 17, (new) Claim 29, and Claim 26 dependent upon Claim 29. The size changer 23 of Taylor et al is disposed between his frame store 14/24 and his disc store 18/20, and therefore supplies only reduced (or expanded) images to the disc store 18/20 (contrary to the Examiner's statement that both full and reduced images are stored in the disc store). Taylor et al thus teaches the use of a size change process each time a video image is supplied from the frame store 14/24 to the disc store 18/20 (FIGS. 5. 19), and also when the image is supplied from the disc store back to the frame store (FIGS. 18, 19).

On the other hand, Applicant's size reducer 26 is bidirectionally coupled only to his frame store 22, and is responsive to the frame store to supply a reduced size image at such time as only a full size image is stored in the frame store. In addition, Applicant's frame store 22 then supplies both the full size image and its corresponding reduced size image back to his disc store 24 for storage together. Subsequently, the full size images individually are returned to the frame store 22, or any number of the selected plurality of the reduced size images are returned for storage in the frame store 22, whereupon such re-stored images can be repeatedly read out.

Note further, that in Applicant's system, it is the frame store 22 which is accessed to provide the image output for display, further use, etc. More particularly, the frame store 22 has two modes of access; first, it receives and stores a full size image, which then is repeatedly read out from the frame store 22; or second, it receives and stores all (or part of) a plurality (e.g., 16) of reduced size images, which then are all (or partially) repeatedly read out from the frame store 22 simultaneously as a single mosaic of whatever plurality of reduced size images was stored in the frame store 22. That is, in the second mode, all of the stored, reduced size images are outputted for display simultaneously in a single video picture, each in its assigned two-dimensional location in the picture raster.

Taylor et al fails to provide or intend the above discussed features.

Accordingly, Claim 16 now recites inter alia, means for storing in a second memory (i.e., frame store 22) the second lower resolution pixel data <u>together with a</u> (full) first resolution pixel data, and means for accessing the <u>second</u> memory to supply either the first resolution pixel data (one full video image), <u>or</u> the second resolution pixel data (multiple reduced video images), for further processing. These features are not taught or suggested by Taylor et al.

Claim 17 is dependent upon Claim 16 and further specifies that multiple sets of second resolution pixel data are accessed from selected groups of memory locations in the second memory...to allow simultaneous read out and display of the multiple sets of data at the second resolution in a single composite mosaic. These features also are not taught or suggested by Taylor et al.

Likewise, Claim 29 include steps of providing data sets for a plurality of full size images, generating a like plurality of reduced size images from the respective data sets of full size images, storing both the full size data sets and the reduced size data sets in respective groups of storage locations, and selectively accessing either, one of the full size data sets or (all) of the reduced size data sets simultaneously. Claim 26 further recites steps of storing the plurality of full size images and their reduced size images, in respective groups of storage locations, and retrieving the reduced size images and storing them in a random access memory. The Claim 26 continues with outputting the plurality of reproductions (of the reduced size images) as a full size mosaic, etc.

These features of Claims 29 and 26 are not taught or suggested in Taylor et al.

For the same reasons as above, Claim 23 recites language which is not anticipated by Taylor et al. In Claim 23, a first store stores video data representing a full size video image as well as the reduced size video image

corresponding to the full size video image, a second store receives and stores a plurality of full size video images and a like plurality of the reproductions thereof at a fractional-size. Claim 23 further includes means for transferring either one of the full size video images, or the plurality of reproductions as a full image, from the second store to the first store.

These features also are not taught or suggested in Taylor et al.

Accordingly, Applicant respectfully submits that the rejection of Claims 2-4, 6, 7, 15-28 (and 29) under 35 USC 112, second paragraph, is overcome for reasons given above, and that amended Claims 16, 17, 23-26 are not anticipated by Taylor et al but are allowable thereover as discussed above. Action in the form of allowance of Claims 2-4, 6, 7, 15-23, 26-29 is earnestly solicited.

If Examiner finds slight differences that can be resolved by a telephone interview, Applicant hereby requests leave for such interview by telephoning the undersigned collect at (415) 367-3331.

Respectfully submitted,

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Dated: April 27, 1988

401 Broadway, M.S. 3-35
Redwood City, CA 94063-3199

United States Patent [19]

Harada et al.

[11] **Patent Number: 4,802,019**

[45] **Date of Patent: Jan. 31, 1989**

[54] **PICTURE PROCESSING SYSTEM FOR SELECTIVE DISPLAY**

[76] Inventors: Zenji Harada, 2-25-2, Uguisudai, Kawanishi-shi, Hyogo-ken; Osamu Teranka, 13-7, Akasakadai 5-chome, Saiki-shi, Osaka; Tsuneo Mikado, 4-1-5-307, Shimomeguro, Meguro-ku, Tokyo, all of Japan

[21] Appl. No.: 862,041

[22] Filed: May 12, 1986

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 455,115, Jan. 3, 1983, abandoned.

[30] **Foreign Application Priority Data**

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Jan. 20, 1982 [JP] Japan 57-6971

[51] Int. Cl.[4] H04N 5/76
[52] U.S. Cl. 358/335; 369/32; 360/10.1; 360/72.2; 360/33.1; 358/183; 340/707
[58] Field of Search 369/30, 32; 360/10.1, 360/72.2, 33.1, 35.1, 9.1; 358/335, 183, 342, 22; 340/721, 723, 724, 731, 747, 707

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Primary Examiner—Alan Faber
Attorney, Agent, or Firm—Woodcock Washburn Kurtz Mackiewicz & Norris

[57] **ABSTRACT**

A picture processing system for displaying a plurality of still pictures recorded in a recording member. The recording member has index tracks for storing a series of information representative of a plurality of squeezed still pictures corresponding to the original still pictures. A group of squeezed still pictures is displayed in multiple segmented areas formed on an index screen accompanied by reference numerals. A light pen and a sensing circuit is provided for rearranging the index screen. The light pen detects the position of said segmented areas and intermediate regions respectively provided between two adjacent areas for processing the rearrangement.

9 Claims, 4 Drawing Sheets

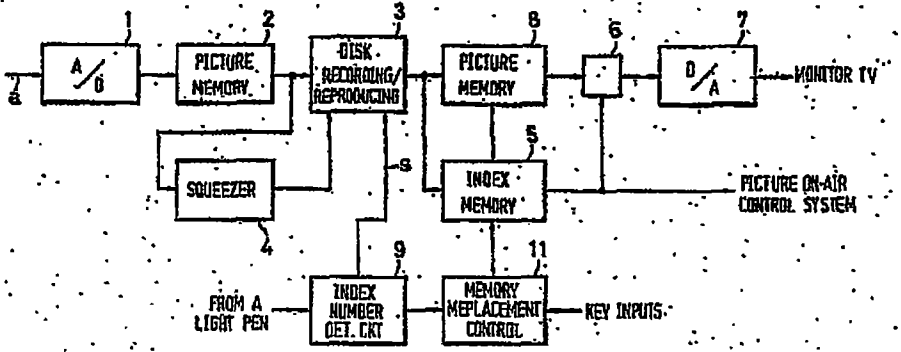

EXHIBIT NO. 2
Harada 4/17/06
(WITNESS) (DATE)
JANIS JENNINGS, CSR 3942

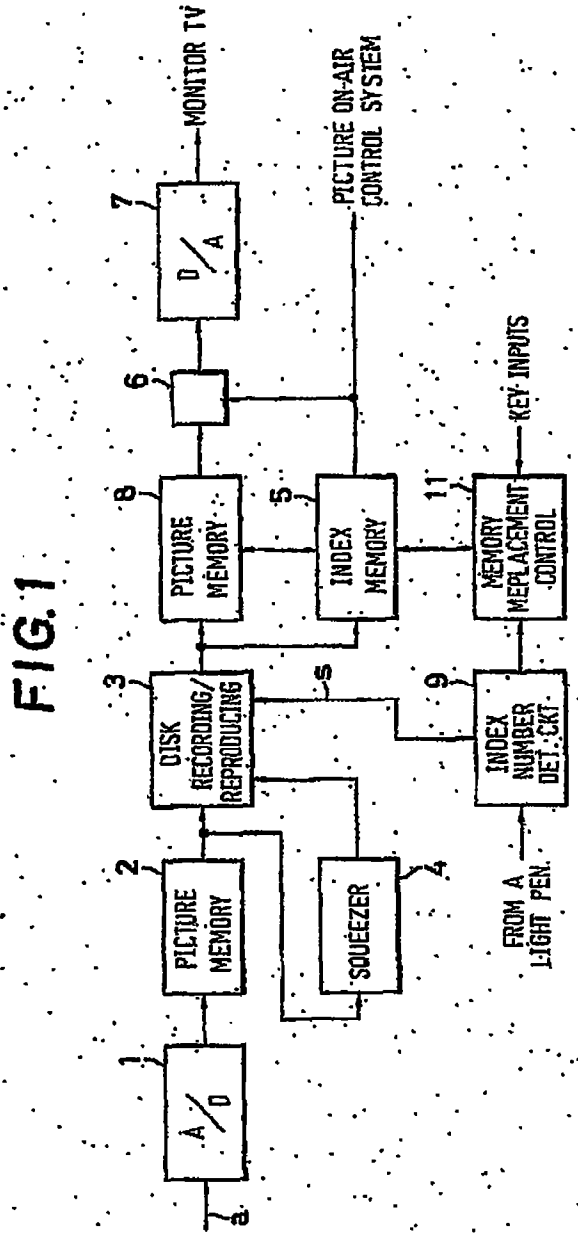
MONITOR TV
PICTURE ON-AIR CONTROL SYSTEM
KEY INPUTS
D/A
A/D
PICTURE MEMORY
PICTURE MEMORY
INDEX MEMORY
MEMORY REPLACEMENT CONTROL
DISK RECORDING/ REPRODUCING
INDEX NUMBER DET. CKT.
SQUEEZER
FROM A LIGHT PEN
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FIG. 1

FIG. 2

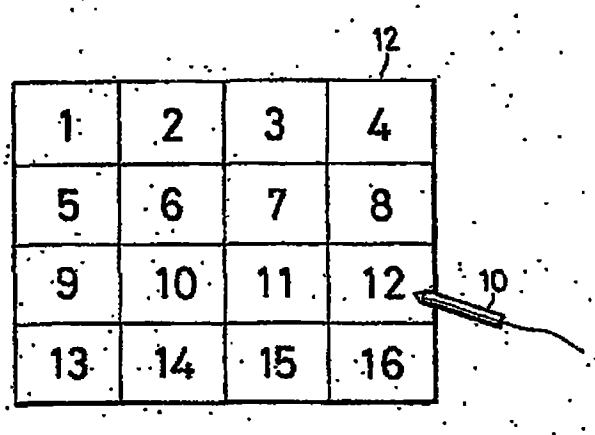
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FIG. 3

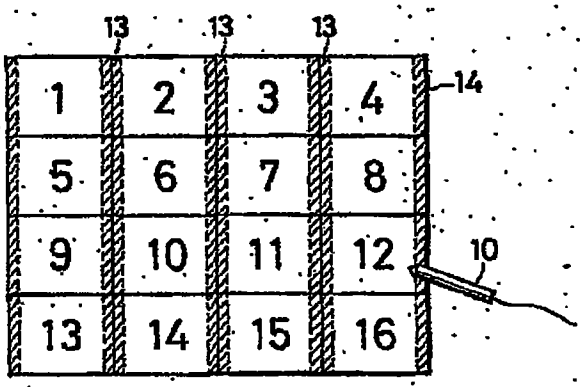
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FIG. 4

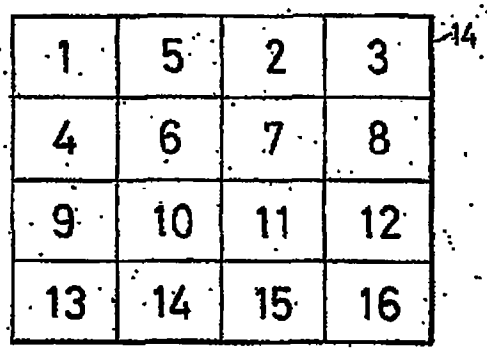
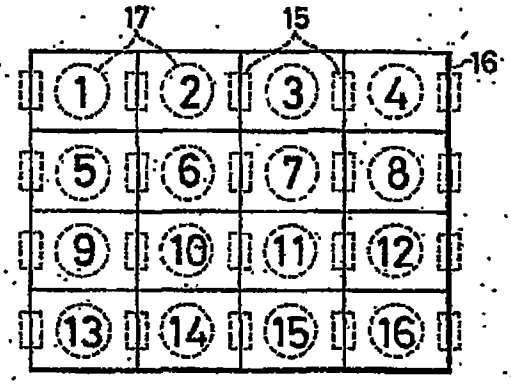


FIG. 5



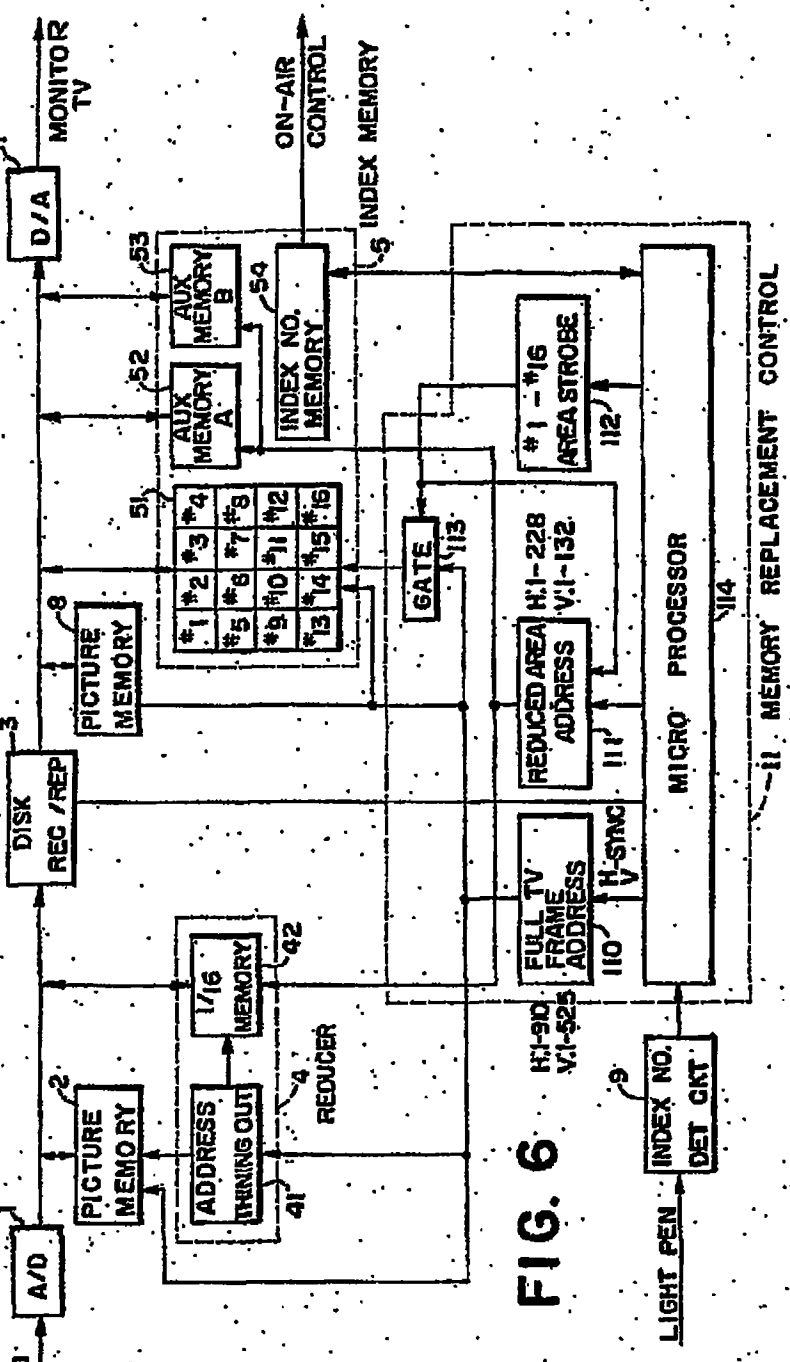


FIG. 6

PICTURE PROCESSING SYSTEM FOR SELECTIVE DISPLAY

This is a continuation-in-part of U.S. application Ser. No. 455,115, filed Jan. 3, 1983, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a picture processing apparatus for selecting a desired picture from a plurality of still pictures formed on a monitor screen by means of selecting means and rearranging them in a desired order.

2. Description of the Prior Art

A picture display system for reproducing digital information representative of a plurality of still pictures (about 100 fields, for example) recorded in a disk type recording medium and displaying it on a monitor has been well known as prior art. Such a system as this is generally used, in a TV station for example, for a programming apparatus of a picture on-air control system by which programs in a predetermined order arranged in advance are automatically progressed by use of a plurality of VTRs. In this programming apparatus, picture or character information representative of the contents of each program such as news program or commercial program is recorded in a floppy disk and the like in the form of one still picture information. This information is rearranged in the desired order while reading it out at the time of making the program. The picture on-air control system is controlled with the rearranged information.

In this type of programming apparatus, it generally takes approximately 0.4 sec. to reproduce the still picture of one field and a time interval of 1.6 sec. is required for the case of color picture consisting of four fields in one unit of color frame. Thus, an extremely large amount of time is required to find out the desired pictures. Alternatively, a method of selecting the desired picture information through an index in the form of a document is conceivable but it is impossible to express the contents of the picture completely by use of the document and it also takes alot of time to fabricate such index as mentioned above.

A picture display system was proposed by the same assignee as that of this invention in U.S. patent application Ser. No. 437,317, filed on Oct. 25, 1982, now abandoned, in which the problems mentioned above are settled. In the picture display system, a plurality of still pictures are recorded in a recording member. The recording member has index tracks for storing a series of information representative of a plurality of squeezed still pictures corresponding to the original still pictures. An index screen is formed on which a group of squeezed still pictures is displayed in multiple segmented areas prepared on the screen accompanied by reference numerals.

By using this type of index screen, program arrangement tasks can drastically be simplified. In short, the contents of the plurality of still pictures can be observed at a glance by looking into the index screen without having to reproduce and display them one by one. In addition, a program advancing schedule can be completed by selecting the pictures on the index screen in the desired order.

It will also be possible to know the schedule of programs through the index screen. In short, the scheduled programs can be displayed on the index screen with an

arrangement of squeezed picture elements. The programmed index screen can be formed by selecting the squeezed pictures in order of program, storing the selected picture information in a picture memory one after another and then reading out the programmed information. In this case, alteration or rearrangement of program requires replacement or insertion of the squeezed pictures on the index screen indicating an arrangement in accordance with a certain schedule.

Generally, the selection, replacement and insertion of the squeezed pictures on the index screen are achieved through a key input unit including ten keys for data input and function keys such as "Insert" key, "Change" key or "Execution" key for operation command.

The key input operation in very troublesome when the alteration or rearrangement of program is requested during on-air of the program. And the key input operation is apt to cause errors, resulting in on-air accidents.

SUMMARY OF THE INVENTION

It is therefore a primary object of the present invention to settle such drawbacks as mentioned above, that is, to accomplish quick selection of the desired pictures from a plurality of squeezed still pictures on the index screen.

Another object of the present invention is to accomplish simple and accurate insertion of the selected pictures into the desired positions between the still pictures arranged on the index screen.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention, its construction and mode of operation, reference is made to the following description of preferred embodiments and the appended drawings in which:

FIG. 1 shows a block diagram of a picture processing apparatus in accordance with the present invention;

FIG. 2 shows a front view of an index screen used for explaining quick selection of the desired pictures;

FIGS. 3 and 4 show views similar to FIG. 2 and used for explaining simple and accurate insertion of the desired pictures; and

FIG. 5 shows a plane view of an X-Y coordinate input device to be mounted on a screen.

FIG. 6 shows a detailed block diagram of the system of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1 wherein a block diagram of the picture processing apparatus in accordance with the present invention is illustrated, an input video signal a is converted into a series of digital signals and the still picture information of one color frame is written into a picture memory 2. The outputs read out of the memory 2 are supplied to a disk type recording/reproducing apparatus 3 and then recorded therein. By repeating this recording operation, picture information corresponding to a plurality of still pictures can be recorded to the disk. The speed for reading the picture memory 2 is modified so as to match the speed of rotation of the disk.

The outputs of the picture memory 2 are also provided to a "squeezer" or reducer circuit 4. The reducer circuit 4 has a specific function to reduce or "squeeze" the picture size to one-sixteenth the original size and is so constructed that three scanning lines are thinned or removed out of four scanning lines and three sampling points on the scanning line are thinned or removed out

of four sampling points at the time of analog/digital conversion, for example. The outputs of the reducer circuit 4 are fed to the disk type recording/reproducing apparatus 3 and recorded in a predetermined part, that is, tracks assigned for index recording.

In reproduction operation, the outputs reproduced from the index track in the disk type recording/reproducing apparatus 3 are first supplied to an index memory 5 and recorded therein as information for one index screen. The outputs of the index memory 5 are then delivered to a D/A converter 7 through a changeover device 6 and converted therein to analog picture signals. The outputs of the D/A converter 7 are applied to a monitor television (TV) and then displayed on a screen thereof.

As clearly indicated in FIG. 2, the screen 12 of the monitor TV is divided into a plurality of segments (in this example, 16 segments) and each of the "squeezed" still pictures is displayed on each of the segments (1 to 16). To the respective segments, the reference numerals 1 to 16 are assigned by superimposing them on the pictures or by noting them down on a transparent plate located in front of the screen. In this example, the screen 12, including a group of "squeezed" still pictures and reference numerals will be used as an index screen.

Like these, the required information can be selected by looking into the index screen 12 of FIG. 2. The selected still picture information will be reproduced by giving instructions representative of the index reference numerals to the disk type recording/reproducing apparatus 3, which can access in a random manner to any one of the required tracks. The reproduced signals will be recorded in the picture memory 8. As previously described, the outputs of the picture memory 8 will be fed to the monitor TV via the changeover device 6 and the D/A converter 7 and displayed on the screen 12 thereof as a selected still picture.

In this paragraph, the selection of the desired still pictures by utilization of the index screen 12 illustrated in FIG. 2 will be concretely explained. The index reference data representing a respective "squeezed" picture can be detected by means of a light pen 10. The information corresponding to the desired index number is detected through a detecting circuit 9 by directing the light pen 10 onto one of the "squeezed" still pictures to be selected.

The output of the detecting circuit 9 is provided to the disk type recording/reproducing apparatus 3 on line S. A selected still picture information is reproduced therefrom, and then recorded in the picture memory 8. The outputs of the picture memory 8 are provided to the monitor TV through the changeover device 6 and the D/A converter 7 and displayed on the screen thereof as a selected still picture pattern.

Next, the selection, replacement and insertion operation for "squeezed" index pictures in the case where a second index screen 14 shown in FIG. 3 is utilized instead of the first index screen 12 will be explained. As clearly indicated in FIG. 3, the second index screen 14 is provided with intermediate regions 13 between the respective segments. The intermediate regions 13 can be represented by gate signals produced on the basis of horizontal and vertical sync signals and detected depending on the gate signals at a time when the intermediate regions 13 are designated by means of the light pen 10.

In making a desired schedule of TV programs, the operator reads out index pictures from the apparatus 3 just as mentioned before and then selects the picture displayed on the index screen 14 in the desired order by means of the light pen 10 to obtain a series of picture selection information. The output of the index number detecting circuit 9 is fed to a memory replacement control circuit 11 in response to the key input signals selected on a keyboard (not shown). The "squeezed" picture information selected through this step is transferred to the picture memory 8 in the selected order. At the same time, the index reference numbers corresponding to the selected pictures are stored in a schedule memory portion of the index memory 5 in the designated order.

When a series of schedules have been completed, the contents of the picture memory 8 are transferred back to the index memory 5 through the manipulation of an "End" key on the keyboard. The contents of the index memory are displayed on the monitor screen through the changeover device 6 and the D/A converter 7 and the scheduled program sequence 1, 2, 3 . . . can be observed on the so called multi-screen 14 shown in FIG. 3.

The sequence of the pictures in the programs may be modified by instructing the picture on the multi-screen by means of the light pen. For example, when the sequence of programs represented by the "squeezed" pictures 6, 7 for example, is to be replaced for example by rearranging the order of that pair of pictures in the sequence, the operator designates the screen segments 6 and 7 to be changed by means of the light pen 10 and manipulates a "change" key on the keyboard. As the result, the memory replacement control circuit 11 is operated so that the "squeezed" picture information corresponding to regions 6, 7 in the index memory 5 is mutually replaced and, at the same time, the index reference numerals written in the schedule memory portion within the index memory 5 are mutually replaced.

Next, rearrangement of the index memory 5 by the operation of inserting another program into the already-scheduled programs will be explained in detail in connection with ordinal methods.

In one typical method, it is assumed that the "squeezed" picture 5 is to be inserted between the "squeezed" pictures 1 and 2, for example. The operator first designates the picture 1 and then the picture 5 by use of the light pen 10 and thereafter manipulates an "Insert" key on the keyboard. The memory replacement control circuit 11 is thereby operated similarly to the above-mentioned replacement operation. As a result, the picture 5 is inserted between the pictures 1 and 2 and the pictures 2, 3 and 4 are shifted by one segment, in order, respectively. This insertion process, however, is liable to lead to error because, when the operator wishes to insert the picture 5 before the picture 2, he may erroneously designate the pictures 2 and 5 in this order by use of the light pen 10 and thereafter manipulate the "Insert" key without following the correct steps: 1→5→, "Insert" key. This operation would result in the mistaken rearrangement: 1, 2, 5, 3 and 4.

To prevent such erroneous operation as this, in this embodiment, the intermediate region 13 is provided between the respective segments on the index screen, as indicated by the hatched region in FIG. 3. As described previously, this intermediate region 13 can be represented by the gate signals produced based on the horizontal and vertical sync signals and it can be detected on the basis of the gate signal obtained when the operator designates the intermediate region 13 by use of the light pen 10.

Now it is assumed that the picture 5 is to be inserted between the pictures 1 and 2 by utilization of the intermediate region 13. In this case, the operator first designates the picture 5 and then the intermediate region 13 located between the pictures 1 and 2 and thereafter manipulates the "Insert" key on the keyboard. The respective outputs of the index number detecting circuit 9 and the "Insert" key are thereby fed to the memory replacement control circuit 11 and the insert operation for the "squeezed" pictures and the reference numerals is carried out. As a result, such a rearranged program as shown on the monitor screen 14 in FIG. 4 is obtained. As clearly understood from the foregoing, the aforesaid insertion process is extremely simple and any erroneous operation can be avoided.

An X-Y coordinate input device may be used as well as the light pen 10. This input device may be a conventional one which is formed by arranging transparent electro-conductive films and the like in the form of a key switch train 17 in a form of matrix as indicated in FIG. 5. The necessary pictures can be selected by disposing the transparent input device over the monitor screen so as to touch it directly and manipulating some of the coordinate keys corresponding to the "squeezed" index pictures on the monitor screen.

In addition, if a key switch train 15 corresponding to the intermediate region 13 of FIG. 3 is arranged between the key switch trains 17 located on the respective picture segments as shown in FIG. 5, they can be used at the time of insertion operation. Since the insertion operation is just similar to the case of the light pen, the operator first selects the pictures to be inserted by use of the key switch train 17 and then manipulates the key switch train 15 showing the position for insertion.

As clearly understood from the foregoing, the picture processing apparatus of this invention is so constructed that the "squeezed" still pictures can be displayed on one screen divided into a plurality of segmented areas and each segment and the intermediate between the segments can be selected on the screen. Rearrangement operation of the multiple segmented screen, such as insertion operation, can be easily achieved without errors, by designating one of the segments and one of the intermediate regions.

FIG. 6 shows a detailed block diagram of the system of FIG. 1. In FIG. 6, a digitized video signal from the analog-digital converter 1 is stored in the picture memory 2 having a size corresponding a full TV frame area. A write address is supplied to the memory 2 from a full TV frame address generator 110 for recording the full frame picture data. The address consists of horizontal picture element and vertical addresses 1-910 incremented by one for each horizontal picture element and vertical addresses 1-525 incremented by one for each horizontal line. The content of the picture memory 2 is read out to be recorded on a track of the disk recording-/reproducing apparatus 3. Read address is supplied from the full TV frame address generator 110 to the picture memory 2 at a slow rate corresponding to the recording speed of the disk apparatus 3.

For reducing a full frame image into 1/16 of the original, a read address is supplied from the full TV frame address generator 110 through an address circuit 41 which passes only addresses having a bit pattern (01) in the rightmost two bits thereof. Addresses having other bit patterns (00, 10 and 11) in the rightmost two bits are not passed. It means that horizontal and vertical addresses representatives of 1, 5, 9 . . . are supplied to the picture memory 2 to read out a reduced picture being one-fourth both in horizontal and vertical directions. At the same time, a write address is supplied to a 1/16 memory 42 for storing the read-out reduced picture data from the picture memory 2. The write address is identical with the thinned out address from the address thinning out circuit 41 but the rightmost two bits (01) thereof are deleted. The write address designates 1/16-sized memory area for storing the reduced picture image and consists of horizontal H and vertical V addresses incrementing by one, representing 1-228 (H) and 1-132 (V).

The content of 1/16 memory 42 are read out and transferred to the disk apparatus 3 to be recorded on an index track thereof. A read address is supplied to the 1/16 memory 42 from a reduced area address generator 111 at a slow rate corresponding to the recording speed of the disk. The address generator 111 generates horizontal and vertical addresses H-address 1-228 and V-address 1-132 respectively.

The control circuit of the disk drive 3 selects still picture tracks and reduced picture tracks in accordance with the signal to be recorded under the control of micro processor 114.

For reproduction, data representing a reproduced picture is stored in the picture memory 8 and the stored data is read out to a monitor TV 12 (See FIG. 2) through the digital-analog converter 7. A write address and a read address are generated in the full TV frame address generator 110 and supplied to the picture memory 8. The rate of the write address is synchronized with the reproduction from disk 3 and the rate of the read address is synchronized with the time base of the real video signal.

The index memory 5 comprises a full TV frame memory 51 for storing data corresponding to one index still picture which consists of 16 segmented areas in each of which a reduced picture corresponding to one full frame TV still picture is displayed. Each of the multiple segmented areas corresponds to a predetermined location in the memory 51. Each of the predetermined locations has a unique address and stores the digital signals (i.e. data) for one reduced still picture image. Write and read addresses are supplied in the same manner with the write and read operation of the picture memory 8, thus displaying an index picture on the monitor screen.

The index memory 5 further comprises two auxiliary memories 52 and 53 labeled as "A" and "B", which are employed for memory replacement control. Each of the auxiliary memories is the same size as the 1/16 memory 42 for storing the data of one reduced picture. The reduced area address generator 111 supplies write and read addresses (1-228 (H) and 1-132 (V)).

An area strobe signal generator 112 is provided in the memory replacement control circuit 11. The generator 112 generates a strobe signal corresponding to one of the segmented areas #1-#16 within one index picture. The strobe signal is generated in synchronism with the full frame address generation by the full frame address generator 110.

Rearrangement of the reduced still pictures in the index picture will now be explained. "Rearrangement" and similar words are used to refer generically to either the exchange of locations of two reduced still pictures in the index picture or the movement of one reduced still picture image at an initial location in the index picture in a new location between a pair of adjacent reduced still pictures in the index picture. With respect

to the described embodiment, rearrangement and similar terms refer to the steps of relocating reduced still picture image digital signals in the index memory among the predetermined memory locations to accomplish the aforesaid modifications to the index picture.

For exchange of two of 16 segments in the index memory 51, the two segments, #6 and #7 for example, are designated by a light pen, the operation of which is detected by the index number detection circuit 9 and acknowledged to the micro processor 114. The processor 11 gives a command signal to the area strobe signal generator 112 to generate #6 and #7 strobe signals in that order. The strobe signals are supplied to a gate circuit 113 for strobing a full frame read address from the address generator 110.

Strobed addresses corresponding to segments #6 and #7 are fed in this order to the index memory 51 for reading out the data in the segments #6 and #7. Simultaneously, write addresses are supplied from the reduced area address generator 111 to the auxiliary memories 52 and 53 in synchronism with respective timing of the strobe signals. As a result, contents of the segments #6 and #7 are respectively transferred to the memories 52 and 53 (#6→A, #7→B).

Then, strobe signals for segments #7 and #6 are generated in that order to strobe and feed write addresses from the full TV frame address generator 110 to the index memory 51 through the gate circuit 13, while read addresses are supplied to the auxiliary memories 52 and 53 in synchronism with the strobe signals. As a result, contents of the auxiliary memories 52 and 53 are retransferred to the segment areas #7 and #6 (A→#7, B→#6), thus completing the exchange of reduced pictures digital signals stored in the index picture memory between the index memory locations for multiple segment locations #6 and #7.

For insertion of one selected segment between two adjacent segments, a segment, for example, is first designated and then one of intermediate regions 13 located between a pair of segments; the region 13 between segments #1 and #2, for example, is designated by a light pen. The detecting circuit 9 detects these designations and sends appropriate signals to the micro processor 114. The micro processor 114 controls the full TV frame address generator 110, reduced area address generator 111 and area strobe signal generator 112 in the similar manner as explained in the exchange mode. Following five steps are carried out in the insertion operation.

(1)	#5→A
(2)	#4→B→#5
(3)	#3→B→#4
(4)	#2→B→#3
(5)	A→#2

Segment #5 is moved to memory 52 for storage. Each segment #4 through #2 is moved to the remaining memory 53 (B) and then to the next higher segment location freeing the segment 2 location into which the contents of memory (52) is read. Consequently, the reduced picture in the #5 segment is inserted between segments #1 and #2 so as to complete the rearrangement shown in FIG. 4.

An index number memory 54 is employed in the index memory 5. In the index number memory 54, index numbers corresponding to the arrangement of index segment pictures on the index screen are stored under control of the micro processor 114. The content of the index number memory 54 is read out as a program schedule information to be used for on air control.

This invention having been described in its preferred embodiments, it is clear that numerous modifications and changes may be made by those skilled in the art without departing from the broader scope and spirit of the invention.

What is claimed is:

1. A picture processing system comprising a recording member in which a plurality of full TV screen still picture digital signals is recorded, each signal corresponding to a different still picture, and a monitoring means for reproducing one of said still picture digital signals and displaying the corresponding still picture on a screen, said recording member having an index recording portion in which a second plurality of digital signals is recorded, each digital signal of the second plurality corresponding to a reduced still picture and one reduced still picture digital signal being provided for each still picture, and said monitoring means including: index memory means for storing a group of reduced still picture digital signals from said recording member in predetermined memory locations as a single full TV screen index picture; circuit means for coupling the index memory means and said screen to display the group of said reduced still pictures stored in said index memory means in multiple segmented areas on said screen as an index picture; selecting means for designating multiple segmented areas on said screen to select reduced still pictures displayed in said areas; a detecting circuit for detecting the position of segmented areas designated by said selecting means on the basis of horizontal and vertical sync signals for said screen, said detecting circuit including means for detecting intermediate regions respectively provided between adjacent segmented areas on said screen; and memory control means for rearranging the locations of said reduced still picture signals stored in said index memory means on the basis of the output of said selecting means to rearrange the location of reduced still pictures in said index picture, said memory control means receiving a detecting signal corresponding to one of said intermediate regions for rearranging the contents of said index memory so that a selective one of said displayed reduced still pictures is interposed between two adjacent reduced pictures by designating an intermediate region between said two adjacent reduced pictures displayed on said screen.

2. A picture processing system according to claim 1, wherein said selecting means further comprises a light pen, said detecting circuit detecting the position of said segmented areas designated by said light pen on the basis of horizontal and vertical sync signals for said screen.

3. A picture processing system according to claim 1, wherein said selecting means comprises a transparent keyboard unit provided on said screen, said keyboard unit comprising a matrix of keys, each key corresponding to each of said segmented areas.

4. A picture processing system according to claim 3, wherein said transparent keyboard unit further comprises another matrix of keys, each key corresponding to each intermediate region respectively provided between each pair of adjacent segmented areas and said memory control means receives the output of one of said another matrix of keys corresponding to one of said

intermediate regions for rearranging the contents of said index memory so that a selected one of said displayed reduced pictures is interposed between two adjacent reduced pictures by designating an intermediate region between said two adjacent reduced pictures displayed on said screen.

5. A picture processing system according to claim 3, wherein said transparent keyboard unit further comprises another matrix of keys, each key respectively corresponding to an intermediate region between different pairs of adjacent segmented areas, said keys at the intermediate regions being utilized to rearrange the arrangement of said reduced still pictures on said screen.

6. A picture system comprising:

a recording member in which a plurality of still picture signals are recorded; and

a monitoring means for reproducing one of said recorded still picture signals for displaying said one still picture on a screen,

said reproducing member having an index recording portion in which a series of reduced picture signals representative of a plurality of reduced still pictures, each of which correspond to each of said still pictures, is recorded,

a group of said reduced still pictures being selectively displayed in multiple segmented areas formed on said screen as an index to said still pictures, said monitoring means comprising selecting means of a type operative by directly pointing to the surface of said screen for designating one of said multiple segmented areas to select one of said reduced still pictures, and a detecting circuit for detecting the position of said segmented areas designated by said selecting means on the basis of horizontal and vertical sync signals for said screen, said detecting circuit including means for detecting intermediate regions respectively provided between adjacent segmented areas on said screen, a detecting output thereof being utilized to rearrange the arrangement of said reduced still pictures on said screen, and said monitoring means having a random access reproduction function to reproduce one of designated still pictures in response to designation with said selecting means.

7. A picture processing system according to claim 6, wherein said selecting means further comprises a light pen, said detecting circuit detecting the position of said segmented areas designated by said light pen on the basis of horizontal and vertical sync signals for said screen.

8. A picture comprising system according to claim 6, wherein said selecting means further comprises a transparent keyboard unit provided on said screen, said keyboard unit comprising a matrix of keys corresponding to said segmented areas.

9. A picture processing system comprising:

a random access recording and playback member having a main recording portion in which a plurality of still picture signals are electronically recorded and an index recording portion in which a plurality of reduced still picture signals are electronically recorded, each of the reduced still pictures corresponding to a different one of said still pictures; and

a monitoring means including: a screen for displaying either a group of said reduced still pictures in multiple segmented areas formed on said screen as an index to said still pictures or one of said still pictures; selecting means for designating one of said multiple segmented areas to select the reduced still picture displayed therein by directly pointing to the surface of said screen, and for controlling said random access recording and playback member; means for electronically recording the signal of the one still picture corresponding to the selected one of said reduced still pictures; and a detecting circuit for detecting the position of said segmented areas designated by said selecting means on the basis of horizontal and vertical sync signals for said screen, said detecting circuit including means for detecting intermediate regions respectively provided between adjacent segmented areas on said screen, a detecting output thereof being utilized to rearrange the arrangement of said reduced still pictures on said screen.

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United States Patent [19]

Beaulier

[11] **Patent Number: 4,821,121**

[45] **Date of Patent: Apr. 11, 1989**

[54] **ELECTRONIC STILL STORE WITH HIGH SPEED SORTING AND METHOD OF OPERATION**

[75] Inventor: Daniel A. Beaulier, Menlo Park, Calif.

[73] Assignee: Ampex Corporation, Redwood City, Calif.

[21] Appl. No.: 18,786

[22] Filed: Feb. 24, 1987

Related U.S. Application Data

[63] Continuation of Ser. No. 740,297, May 31, 1985, abandoned, which is a continuation of Ser. No. 483,327, Apr. 8, 1983, abandoned.

[51] Int. Cl.[4] H04N 5/14

[52] U.S. Cl. 358/160; 358/183

[58] Field of Search 358/160, 183, 311, 342, 358/102; 360/35.1, 9.1, 10.1, 14.1

[56] **References Cited**

U.S. PATENT DOCUMENTS

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4,172,264	10/1979	Taylor et al.	358/185
4,302,776	11/1981	Taylor et al	358/160

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Hugh Boyd, "The DLS6000—A New Digital Still Store Library System", International Broadcast Engineer, vol. 11, No. 170, pp. 46–48.

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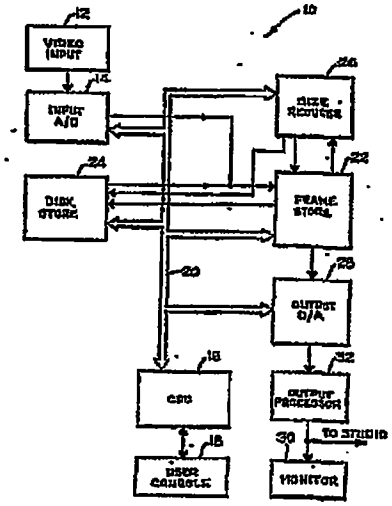
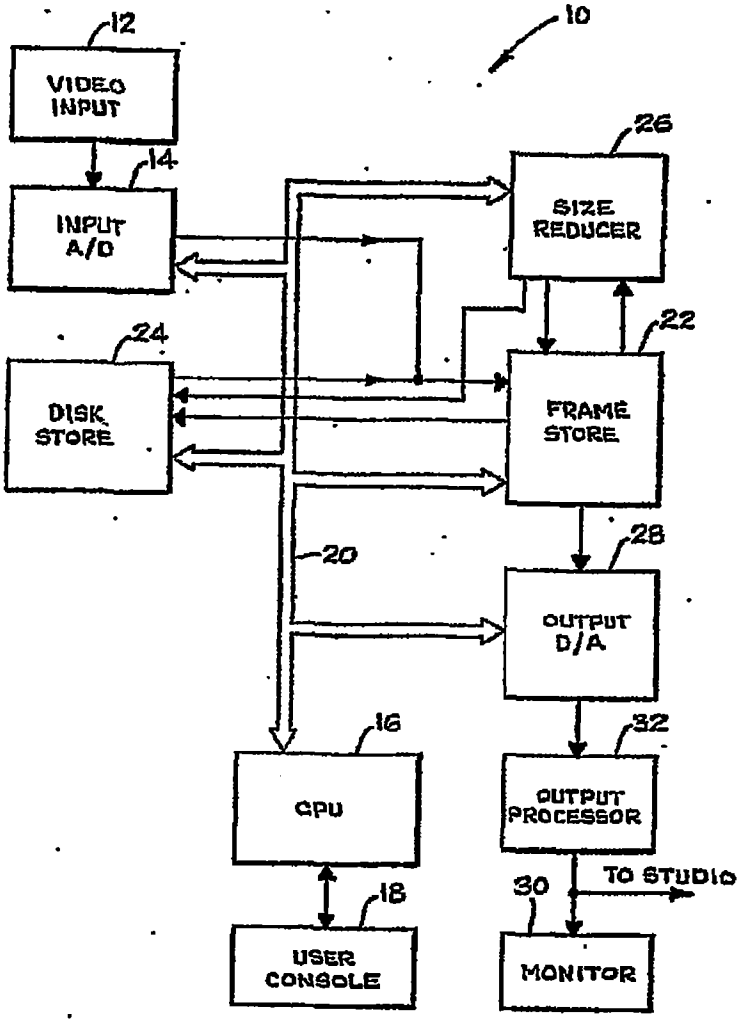
Assistant Examiner—David E. Harvey
Attorney, Agent, or Firm—Bradley A. Perkins; Ronald C. Fish; George B. Almeida

[57] **ABSTRACT**

An electronic still store system stores and selectively outputs video image data defining a plurality of signal frame still images. The simultaneous display of up to 16 or more quarter sized images for scanning or sorting by an operator is facilitated by generating a quarter sized copy of each newly received image frame and storing both together on a conventional magnetic disk storage device as is typically employed in general purpose digital computing systems. The quarter sized image can then be recalled directly for a multi-image scan or sort function in which 16 reduced size images are displayed simultaneously without the time delays associated with the retrieval and size reduction of 16 full size images.

15 Claims, 1 Drawing Sheet




10
12
VIDEO INPUT
14
INPUT A/D
26
SIZE REDUCER
22
24
DISK STORE
FRAME STORE
20
28
OUTPUT D/A
16
32
CPU
OUTPUT PROCESSOR
TO STUDIO
30
18
USER CONSOLE
MONITOR

ELECTRONIC STILL STORE WITH HIGH SPEED SORTING AND METHOD OF OPERATION

This is a continuation of application Ser. No. 740,297, filed on May 31, 1985, now abandoned, which is a continuation of application Ser. No. 483,327, filed Apr. 8, 1983, now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to a digital electronic still store for broadcast television signals and more particularly to a still store providing a high speed multiimage scan or sort capability.

Digital electronic still store video display systems store a plurality of frames of video images on relatively low cost magnetic disk stomge. Any selected one of the stored image frames may then be communicated to a frame store from which data defining the image is repetitively read out to generate a continuously displayed television image. The still store image can then be combined with a second image to create a combined video image. For example, it is common to insert a selected still store image depicting a news event in the upper left hand corner of a live studio image depicting a newscaster describing the news event.

The disk store is capable of storing a large library of single frame images and it is often desirable to generate a reduced size multiple image picture for editing or other purposes. For example, it might be desirable to create a special effect with multiple images or an editor may wish to view and compare several images at the same time for the purpose of selecting those images which will be used in a television broadcast. However, each of the several images which are to be simultaneously displayed must first be read from the disk store as full size images and then reduced for insertion into the multi-image display. This process takes ¼ to ½ second for each image and results in a delay of several seconds for the composite multi-image display. Such a time delay is at best disconcerting for a busy editor and precludes use of the editing features of the system during a real time broadcast.

U.S. Pat. No. 4,172,264, "Control Arrangement for Video Synchronizers", to Taylor et al describes an arrangement in which joysticks may be used to selectively position video images on a television display. The system requires full sized images to be accessed and then reduced in size as described above.

U.S. Pat. No. 4,302,776, "Digital Still Picture Stomge System With Size Change Facility", to Taylor et al discloses a still store system in which multiple images may be accessed and reduced in size for simultaneous display as discussed above. The suggestion is made that an array of reduced size images be stored as a single image frame. This has the effect of eliminating the time required to reproduce the array but precludes the flexibility of choosing or repositioning any desired images when recalling the array. Furthermore, the aforementioned time delays are encountered when assembling the original multi-image display.

SUMMARY OF THE INVENTION

An electronic still store system in accordance with the invention rapidly generates and outputs for display to an operator a still image frame comprising a plurality of selectively positioned, reduce size images which may be simultaneously viewed for scanning or editing purposes. The system includes an image store for storing therein a plurality of frames of video images with both a full spatial resolution copy for full size video output and a reduced spatial resolution copy for reduced size video output of each image being stored, and a frame store which is operable in a first mode to receive from the image store, store and repetitively generate a full spatial resolution output image frame. The frame store is operable in a second mode to receive from the image store and store a plurality of reduced spatial resolution image frames. The frame store is further operable in the second mode to repetitively generate an output image frame having an image from each of the plurality of reduced spatial resolution image frames selectively located at a different position within the output image frame.

The system may further include an image size reducer coupled to produce a quarter size reduced spatial resolution image in response to a full resolution image stored by the frame store, a video input, an analog-to-digital converter coupling the video input to the frame store, a monitor for viewing output video images and an output digital-to-analog converter coupled to convert the output video images from a digital form to an analog form for use by the monitor. A central processing unit is connected to receive user commands through a user console and to control the other devices of the system in response thereto.

The image store employed herein is a general purpose magnetic disk storage system as is currently used in general purpose digital computer systems.

In operation the system can rapidly assemble an array of 16 reduced size images for output as a single image frame. A system operator may view the reduced size images simultaneously for rapid scanning of some or all of the stored images within the image store, which is preferably a magnetic disk. Because the images are read from the image store in reduced size and spatial resolution, the output image formation time is approximately the ¼ to ½ second required to transfer a single full size image instead of the several seconds which would be required to transfer 16 full size images prior to resolution reduction and storage as a reduced size image.

Using this system an operator may rapidly scan many still frame images which are stored by the image store or may compile lists of randomly selected image frames for simultaneous viewing as an array of reduced size images. Because of the rapid response rate the system becomes feasible for development and outputting of data frames containing multiple reduced size images on demand during a television broadcast.

BRIEF DESCRIPTION OF THE DRAWING

A better understanding of the invention may be had from a consideration of the following detailed description taken in conjunction with the accompanying drawing in which the sole FIGURE is a block diagram representation of an electronic still store system in accordance with the invention.

DETAILED DESCRIPTION

Referring now to the sole FIGURE, a digital electronic still store system 10 for rapidly assembling as a single image frame an array of reduced size images is shown as including a video input circuit 12. The video input circuit 12 may be another electronic still store system, a TV camera, or some other source of video data from which one or more frames of a video image

may be captured. In the preferred embodiment of the electronic still store system 10, the video signal is processed in component form. A method and apparatus for producing the component information which may be employed is more fully disclosed in the U.S. Pat. No. 4,675,876, issued Sept. 22, 1987 to D. Beaulier, which is assigned to the same assignee as this application, which is incorporated by reference herein. Therefore, the video input 12 will include appropriate video signal decoding means to process video data received from sources that provide the data in an encoded form.

An input analog-to-digital (A-D) converter 14 is coupled to receive an input video signal provided by the video input circuit 12, which typically includes video signal processing circuitry that prepares the signal for conversion by the A-D converter 14. The A-D converter 14 converts the input video signal to a digital form which is suitable for handling and processing by digital circuitry. The input AD 14 receives the video signal from the video input 12 and converts the video signal to the digital sampled data form in which each pixel of video data is represented by three eight bit data bytes defining respectively luminance, red chrominance and blue chrominance components. Conventionally, the chrominance data has half the spatial resolution of the luminance data in the horizontal dimension so that data is produced in a repetitive 4 byte luminance/chrominance component sequence of L1, CR1, CB1, L2—L3, CR3, CB3, L4 and so forth. The single byte representation affords a high dynamic resolution of 256 distinguishable states for each color component. For adequate dynamic resolution, each video component at a sampled data point is preferably defined by at least 6 binary bits providing 64 distinguishable intensities. A central processing unit (CPU) 16 formed from a Z80 microprocessor is connected to receive operator commands from a user console 18. CPU 16 is connected for bidirection communication of commands and other data over a system bus 20. The system bus 20 is connected to input A-D 14 as well as other major components of the still store system 10 to carry the address, mode select and status information required to control the operation of the still store system 10.

A frame store 22 which in the preferred embodiment is a random access memory, is coupled to receive mode control information from CPU 16 over system bus 20 and to receive video data representing a frame of a video image from either input A-D 14 or from a multiple frame image store implemented as a magnetic disk drive store 24 in the preferred embodiment but which can be any bulk storage memory device in other embodiments. Frame store 22 is a random access store that is capable of storing more data than is required for a single video image frame.

The storage capacity provided by presently available 64K memory chips enables storing up to 750 lines of video data. In any event, out of a 525 line NTSC frame of data only about 484 lines represent video data. Because of the two dimensional nature of a video image a quarter size image defined by video data having one-fourth the spatial resolution of a full size image requires one-sixteenth the storage capacity of a full size, full spatial resolution image. A quarter resolution image thus requires the equivalent storage of 30 lines of a full resolution image. In any event the frame store 22 either contains initially or is expanded to contain, storage of video data representing a full resolution full size image, as well as a quarter resolution copy thereof.

A size reducer 26 is connected to be controlled by data from CPU 16 received over the system bus 20. Size reducer 26 is operable to receive video data from frame store 22 to convert the video data to a quarter spatial resolution copy thereof, and communicate the quarter resolution copy back to frame store 22 for storage therein. In a similar fashion, when video data received from disk store 24 does not contain a corresponding quarter spatial resolution copy, size reducer 26 may be employed to generate a quarter spatial resolution copy for subsequent transfer to either frame store 22 or disk store 24. Hence, any time frame store 22 receives a video image frame that does not have a corresponding quarter resolution copy, the size reducer 26 may be used to make such a copy.

As a new frame of video data is transferred from frame store 22 to disk store 24 for more permanent storage, both the full resolution and the quarter resolution copy are transferred. Since the quarter resolution copy is represented by only one-sixteenth the data of a full resolution copy, the communication and storage of the quarter resolution copy imposes only a small burden on both system operating time and extra storage space requirement within disk store 24. It should be noted that disk store 24 is a general purpose magnetic disk storage device as is commonly used in connection with general purpose digital computing systems.

During system 10 operation frame store 22 repetitively accesses stored video data to generate a continuous stream of output video data frames representing the stored image. An output digital-to-analog converter 28 receives this digital output data and converts it to an analog video signal which is subsequently supplied to output processor 32. Output processor 32 is a conventional video signal output processor, for forming a television signal in a standard format, which can be used to drive a monitor 30 for viewing of the output video image by a system monitor. The analog video signal form may also be communicated to studio equipment for further use, broadcasting or storage.

When operating in a first, normal broadcast mode, frame store 22 receives a full resolution frame of video data from disk store 24 and outputs a continuous television image in digital data form in response thereto.

In a second, editing or browsing mode, CPU 16 commands disk store 24 to output reduced resolution image data which is selectively positioned in frame store 22 for viewing in one of 16 reduced size image positions in a 4×4 array as a mosaic which fits within a normal full size image. Under operator control, the 16 viewable images may be taken sequentially from disk store 24 starting with a selected image frame. This mode is useful when scanning all of the images stored by disk store 24. Alternatively, the 16 images may be taken randomly from a list of stored images developed by the operator. This mode is especially useful when it is desired to compare certain images.

The 16 image assembly time is greatly reduced because only an amount of data equivalent to one full size, full spatial resolution, image need be transferred from disk store 24 to define all 16 images. This is only one-sixteenth of the time that would conventionally be required.

While there has been shown and described above, a particular arrangement of an electronic still store system which can rapidly compose a multiple image frame of data, for the purpose of enabling a person skilled in the art to make and use the invention, it will be appreci-

ated that the invention is not limited thereto. Accordingly, any modifications, variations or equivalent arrangements within the scope of the attached claims should be considered to be within the scope of the invention.

What is claimed is:

1. An electronic still store system comprising:

an image store means for retrievably storing therein a plurality of image frame copies of video frames, the image frame copies comprising data representing full spatial resolution images and corresponding data representing reduced spatial resolution images of the video frames;

frame store means for receiving and storing in a first mode one of said full spatial resolution images from said image store means and for repetitively generating a full spatial resolution image output, and in a second mode for receiving from the image store means and storing a plurality of said reduced spatial resolution images each at selectively located different positions, the frame store means in the second mode further repetitively generating an image output comprising the stored plurality of said reduced spatial resolution images; and

size reducer means for receiving from the frame store means the stored full spatial resolution image and in response thereto returning to the frame store means a corresponding reduced spatial resolution image, wherein the frame store means receives and stores the returned reduced spatial resolution image while continuing to store the stored full spatial resolution image.

2. The electronic still store system according to claim 1, wherein the reduced spatial resolution images each have a spatial resolution of one-fourth the spatial resolution of the corresponding full spatial resolution image.

3. The electronic still store system according to claim 1, wherein said frame store means includes a central processing unit, controlled by an operator in said first mode for selecting which of said full spatial resolution images stored in said image store means is to be retrieved from the image store means, and in said second mode for selecting which of said reduced spatial resolution images stored in said image store means are to be retrieved and stored in said frame store means, and further for selecting the different positions within a video frame at which each of said retrieved reduced spatial resolution images is stored.

4. The electronic still store system according to claim 3, wherein said frame store means further comprises an output digital-to-analog converter coupled to receive output image data from the frame store means and in response thereto to generate an analog video signal representing an output image; and

a monitor coupled to receive the analog video signal and display the output image represented thereby.

5. The electronic still store system according to claim 4, further comprising a video input means for generating an input analog video signal representing an input video image and an analog-to-digital converter coupled between the video input means and the frame store means for converting the input analog video signal to a digital form such that digital data representing said input video image is received and stored by the frame store means.

6. A video still store system comprising:

external source means for supplying a full size image data set representing a full size image frame;

a size reducer coupled to receive the full size image data set for producing therefrom a reduced size image data set representing a corresponding reduced size image frame;

an image store for storing a plurality of full size image data sets representing a plurality of full size image frames and for storing a plurality of reduced size image data sets representing a plurality of reduced size image frames, each of said reduced size image data sets corresponding to one of said full size image data sets; and

frame store means for storing one of said full size image data sets from either the external source or said image store, wherein if said image store does not supply a corresponding reduced size image data set, said frame store outputs a copy of said full size image data set to said size reducer, and receives in turn a corresponding reduced size image data set;

wherein said image store stores the reduced size image data set along with the previously stored corresponding full size image data set.

7. An apparatus for storing video pixel data representing video images of a first resolution and, for each each of the images at said first resolution, a corresponding video image at a second resolution, comprising:

random access memory means for storing video pixel data representing one of a succession of full size images at said first resolution and a corresponding reduced size version thereof at said second resolution;

bulk memory means for receiving said video pixel data from said random access memory means and for storing said succession of full size images and the corresponding reduced size versions thereof, and for outputting upon a user's command, either a selected one of the successive full size images or selected ones of the corresponding reduced size versions thereof for direct transfer to, and storage back in, said random access memory means; and

means responsive to said random access memory means for selectively generating one of said corresponding reduced size versions from the respective full size image in said random access memory means, and for transferring the video pixel data representing and the corresponding reduced size version back to the contents of said random access memory means.

8. An apparatus for storing video pixel data as at least one full size image at a first resolution, and at least one reduced size image thereof at a second lower resolution, comprising:

random access memory means having an input port and an output port, for storing the video pixel data presented at the input port;

said video pixel data representing the full size video image at a first resolution being stored in a first group of memory locations in said random access memory means;

bulk storage memory for also storing the video pixel data and for presenting selected groups of video data at said input port for storage by said random access memory means;

size reducing means responsive to said random access memory means for directly receiving said video pixel data stored in said random access memory means representing said full size image at said first resolution, and for reducing said image to the re-

duced size image at the second lower resolution, and for supplying said reduced size image at said second resolution directly back to said random access memory means in a second group of memory locations therein;

control means coupled to said random access memory means, to said bulk storage memory and to said size reducing means, for causing said size reducing means to generate said reduced size image at said second resolution and to supply same to said random access memory means in said second group of memory locations; and

said control means further causing the transfer of the full size and reduced size video pixel data from said random access memory means to said bulk storage memory for storage, and for causing the selective transfer from said bulk storage memory directly into said random access memory means of either said full size image at said first resolution or said reduced size image at said second lower resolution.

9. The apparatus of claim 8 wherein said size reducing means produces said reduced size image at said second resolution with one fourth the spatial resolution of said full size image at said first resolution, and wherein said control means determines the transfer of said reduced size image at said second resolution into said random access memory means for storage at a selected one of 16 predetermined groups of said memory locations.

10. A system for storing video data representing video images which are displayable as rasters of vertically distributed horizontal lines, each represented video image normally occupying a raster of selected vertical and horizontal size, the system comprising:

a video image size reducer having an input for receiving video data representing a video image corresponding to the selected raster size and for generating video data representing a reproduction of said video image at a selected fractional-size of said selected raster size;

a first store for receiving video data for storage and for providing video data therefrom, said first store having a capacity for storing the video data representing the video image corresponding to the selected raster size simultaneously together with the video data supplied by said video image size reducer representing said reproduction of the video image at the selected fractional-size;

a second store for receiving and storing the video data stored in the first store and for providing video data therefrom directly to the first store, said second store further storing video data representing a plurality of additional video images each corresponding to the selected raster size, and video data representing a plurality of additional reproductions at the selected fractional size of said selected raster size; and

means for selectively transferring from said second store directly to said first store either video data representing of the plurality of video images corresponding to the selected raster size, or video data representing a plurality of reproductions at the selected fractional-size of said selected raster size.

11. A method of storing video pixel data comprising:

receiving and storing in selected storage locations in a random access memory, full video pixel data comprising a full size image;

generating from the full video pixel data, reduced video pixel data representing a reproduction thereof in the form of a reduced size image at a lower resolution;

storing the reduced video pixel data representing the reduced size image in additional storage locations in said random access memory along with the full video pixel data;

storing both the full size image and the reduced size image in bulk storage memory; and

selectively transferring either the full size image or the reduced size image from said bulk storage memory into said random access memory for further processing.

12. A video still store system comprising:

an external source for supplying a plurality of full size image data sets representative of corresponding full size images;

an image store for storing said full size image data sets, and for storing a like plurality of reduced size image data sets representing a plurality of reduced size images, each of said reduced size image data sets corresponding to one of the full size image data sets;

a memory for simultaneous storage of one of said full size image data sets and a corresponding one of said reduced size image data sets;

a size reducer means for receiving from said memory the stored one of said full size image data sets, and for producing and returning to said memory the corresponding one of said reduced size image data sets;

said memory being responsive to either the external source or the image store for storing said one of said full size image data sets, and for supplying to the image store both the stored one of said full size image data sets and the corresponding one of said reduced size image data sets;

said memory being responsive to the image store to store at different selected locations the plurality of reduced size image data sets;

said memory further supplying as an output image either the plurality of reduced size image data sets arranged at different locations within the output image, or the full size image data set; and

means responsive to said memory for displaying the output image as a raster scanned video display.

13. A method of storing video pixel data for access and display comprising:

providing data sets for a plurality of full size images at a first spatial resolution;

generating, from the data sets of the full size images, second data sets representing a corresponding plurality of reduced size reproduction images at a second lower spatial resolution;

storing both the data sets of the plurality of full size images and the data sets of the corresponding plurality of reduced size reproduction images in respective selected groups of storage location; and

selectively accessing from the storage locations a data set representing one of the plurality of full size images, and a data set representing one of the corresponding plurality of the reduced size reproduction images, simultaneously.

14. An apparatus for storing video pixel data as at least one full size image at a first resolution, and at least one reduced size image thereof at a second lower resolution, comprising:

random access memory means having an input port and an output port, for storing the video pixel data presented at the input port;

said video pixel data representing the full size video image at a first resolution being stored in a first group of memory locations in said random access memory means;

bulk storage memory for also storing the video pixel data and for presenting selected groups of video data at said input port for storage by said random access memory means;

size reducing means responsive to said random access memory means for receiving said video pixel data stored in said random access memory means representing said full size image at said first resolution, and for producing reduced size pixel data representing the reduced size image at the second lower resolution, and for supplying said reduced size image at said second resolution to said random access memory means in a second group of memory locations therein;

control means coupled to said random access memory means, to said bulk storage memory and to said size reducing means, for causing said size reducing means to generate said reduced size image at said second resolution and to supply said reduced image to said random access memory means in said second group of memory locations;

said control means further causing the transfer of the full size and reduced size video pixel data from said random access memory means to said bulk storage memory for storage, and for causing the selective transfer from said bulk storage memory into said random access memory means of either said full size image at said first resolution or said reduced size image at said second lower resolution; and

wherein said control means also determines the selective transfer of said reduced size image at said second resolution from said size reducing means into said bulk storage memory via the random access memory means.

15. A method of storing video pixel data for access and display comprising:

providing data sets for a plurality of full size image at a first spatial resolution, wherein each one of the full size images occupies upon display a raster of selected vertical and horizontal size;

generating, from the data sets of the full size images, second data sets representing a corresponding plurality of reduced size reproduction images at a second lower spatial resolution;

storing both the data sets of the plurality of full size images and the data sets of the corresponding plurality of reduced size reproduction images in respective selected groups of storage locations;

selectively accessing from the storage locations a data set of one of the plurality of full size images, and one of the sets of the corresponding plurality of the reduced size reproduction images simultaneously;

wherein the step of accessing further includes, retrieving a plurality of reproduction images, storing the retrieved plurality of images in a random access memory, and outputting the stored plurality of retrieved images as a mosaic of reproduction images occupying a raster of the selected vertical and horizontal size.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 4,821,121
DATED : April 11, 1989
INVENTOR(S) : Daniel A. Beaulier

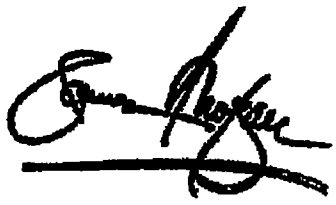
It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 6,
Line 46, please delete "and"

Column 8,
Line 61, please delete ","

Signed and Sealed this

Fourth Day of March, 2003



JAMES E. ROGAN
Director of the United States Patent and Trademark Office

UNITED STATES INTERNATIONAL TRADE COMMISSION

WASHINGTON, D.C.

Before the Honorable Robert L. Barton, Jr.

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In the Matter of CERTAIN DIGITAL IMAGE STORAGE AND RETRIEVAL DEVICES	Investigation No.: 337-TA-527

CONFIDENTIAL

VIDEOTAPED DEPOSITION OF

JUNAID SHEIKH

Friday, May 6, 2005

(Pages 1 - 172)

CONFIDENTIAL BUSINESS INFORMATION

SUBJECT TO PROTECTIVE ORDER

REPORTED BY: JULIE R. HEAD, RPR, CRR, CSR 9399

CERTIFIED ORIGINAL
LEGALINK BOSTON

B-243 to B-246

CONFIDENTIAL INFORMATION,

SUBJECT TO PROTECTIVE ORDER

C O N F I D E N T I A L

UNITED STATED INTERNATIONAL TRADE COMMISSION

WASHINGTON, D.C.

Before the Honorable Robert L. Barton, Jr.

Administrative Law Judge

In the Matter of	)
	) Investigation No.
CERTAIN DIGITAL IMAGE STORAGE	) 337-TA-527
AND RETRIEVAL DEVICES	)

CONFIDENTIAL

Volume 3

Videotaped Deposition of GEORGE LIGLER, PH.D.

Friday, June 3, 2005

Washington, D.C.

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Job No.: 22-57601

Pages: 469 through 603

Reported by: Bess A. Avery, RMR

Cali Day, Videographer

B-248

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CERTIFICATE OF SHORTHAND REPORTER - NOTARY PUBLIC

I, Bess A. Avery, Registered Merit Reporter, the officer before whom the foregoing deposition was taken, do hereby certify that the foregoing transcript is a true and correct record of the testimony given; that said testimony was taken by me stenographically and thereafter reduced to typewriting under my supervision; and that I am neither counsel for, related to, nor employed by any of the parties to this case and have no interest, financial or otherwise, in its outcome.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my notarial seal this 7th day of April, 2005.

My commission expires:
September 14, 2008

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Bess A. Avery

NOTARY PUBLIC IN AND FOR THE
DISTRICT OF COLUMBIA

CX-1561C-1-82

UNITED STATES INTERNATIONAL TRADE COMMISSION
WASHINGTON, D.C.
Before the Honorable Robert L. Barton, Jr.
Administrative Law Judge

In the Matter of CERTAIN DIGITAL IMAGE STORAGE AND RETRIEVAL DEVICES	Investigation No. 337-TA-527

REBUTTAL TESTIMONY OF THOMAS A. GAFFORD

CONTAINS AMPEX'S CONFIDENTIAL BUSINESS INFORMATION, SUBJECT TO PROTECTIVE ORDER DATED DECEMBER 3, 2004

B-251 to B-253

CONFIDENTIAL INFORMATION,

SUBJECT TO PROTECTIVE ORDER

CX-1562C-1-73

UNITED STATES INTERNATIONAL TRADE COMMISSION
WASHINGTON, D.C.
Before the Honorable Robert L. Barton, Jr.
Administrative Law Judge

In the Matter of CERTAIN DIGITAL IMAGE STORAGE AND RETRIEVAL DEVICES	Investigation No. 337-TA-527

REBUTTAL TESTIMONY OF DR. GEORGE T. LIGLER

CONTAINS AMPEX CONFIDENTIAL BUSINESS INFORMATION, SUBJECT TO PROTECTIVE ORDER DATED DECEMBER 3, 2004

B-255 to B-256

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B-257 to B-266

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